

NORTHERN ILLINOIS UNIVERSITY

**An Introduction to the Role of Physical Therapy in
Idiopathic Toe Walking**

A Thesis Submitted to the

University Honors Program

In Partial Fulfillment of the

Requirements of the Baccalaureate Degree

With Upper Division Honors

Department Of

Allied Health and Communicative Disorders

By

Patrice Collins

DeKalb, Illinois

May 14, 2011

University Honors Program

Capstone Approval Page

Capstone Title:

An Introduction to the Role of Physical Therapy in
Idiopathic Toe Walking

Student Name: Patrice Collins

Faculty Supervisor: MJ Blaschak

Faculty Approval Signature MJ Blaschak

Department of Allied Health and Communicative Disorders

Date of Approval: May 5, 2011

HONORS THESIS ABSTRACT THESIS SUBMISSION FORM

AUTHOR: Patrice Collins

THESIS TITLE: An Introduction to the Role of Physical Therapy in
Idiopathic Toe Walking

ADVISOR: MJ Blaschak

ADVISOR'S DEPARTMENT: Allied Health (Physical Therapy)

DISCIPLINE: Physical Therapy

YEAR: 2011

PAGE LENGTH: 12

BIBLIOGRAPHY: Yes

ILLUSTRATED: No

PUBLISHED: NO

LIST PUBLICATION: N/ A

COPIES AVAILABLE: Hard Copy

ABSTRACT: 205 words

Abstract

Idiopathic toe walking (ITW) is a condition, whose cause is unknown, and characterized by a persistent tiptoe gait pattern without evidence of neurologic, orthopedic, or psychiatric disease. Children diagnosed with ITW are typically able to walk with a heel-strike gait for short periods of time when asked to do so. ITW is also known as habitual toe walking, idiosyncratic toe-walking or forefoot walking. Children experiencing ITW may take their first few steps in a heel-to-toe pattern and rise to toe walking only when increasing their speed of ambulation. The diagnosis of ITW is one of exclusion, in which other causes of toe-walking such as equinus, cerebral palsy, autism or myopathy are ruled out. Valuable tools are used in both the diagnosis and assessment of the progression of ITW. Children experiencing toe walking should be evaluated with and without shoes and a thorough musculoskeletal examination should be performed by the PT. Options for the treatment of idiopathic toe walking involve observation, nonoperative and operative management. The prognosis of idiopathic toe walking is favorable with both conservative and surgical treatment. The following paper is a literature review that provides an overview of background information, diagnosis, and evaluation and treatment options for idiopathic toe walking.

Background

Toe walking is considered part of the normal gait spectrum in child development. A toe-to-toe gait pattern can be part of the natural progression of a normal heel-to-toe gait. Toe walking becomes abnormal when it persists past the age of two. Idiopathic toe walking (ITW) is a condition, whose cause is unknown, and characterized by a persistent tiptoe gait pattern without evidence of neurologic, orthopedic, or psychiatric disease. Children experiencing ITW are orthopedically and neurologically normal but they prefer to persistently walk on the balls of their feet. Children diagnosed with ITW are typically able to walk with a heel-strike (heel contact to the ground) gait for short periods of time when asked to do so. It is unclear how often children spontaneously outgrow the habit of toe walking. ITW has alternate names that are sometimes used interchangeably. ITW is also known as habitual toe walking, idiosyncratic toe-walking or forefoot walking. ITW is usually predominant in boys and the family history is commonly extracted.

Diagnosis

Children experiencing ITW may take their first few steps in a heel-to-toe pattern and rise to toe walking only when increasing their speed of ambulation. Children able to put their feet flat while standing or when concentrating on their gait when requested to by physical therapist or physicians, are most likely experiencing ITW rather than any other disorder. The diagnosis of ITW is one of exclusion, in which other causes of toe-walking such as equinus, cerebral palsy, autism or myopathy are ruled out. Diagnosis of ITW should be made with the child walking barefoot. Some observations consistent with diagnosing ITW include: child walks on their toes or balls of their feet in a well coordinated, balanced, and efficient manner, the child is capable of running with minimal to no tripping or falling, and/or the child is capable of walking both

forward and backward easily while on toes. The challenge with diagnosing ITW appears to be how to discriminate it from other medical conditions. Thorough medical history, gait evaluation, musculoskeletal and neurologic examinations are necessary for the purpose of exclusion. A child with ITW will typically have a normal birth and developmental history.

Valuable tools are used in both the diagnosis and assessment of the progression of ITW. These tools include tread mats, electrodynogram and video tape analysis. Tread mats reveal changes that are not always perceptible by the eye and creates a permanent record of a child's gait pattern. An electrodiagnostic gait analysis system places seven sensors on each foot of a child, feeding information into a computer system, whereby pressures, forces, shock, and weight transference patterns can be determined. Videotape analysis provides PT's with the option to compare, one visit to the next, measurements such as heel elevation at any given phase of gait. In recent studies done by Angulo and Stricker, Clark and Sweeny, and Eastwood, the initial diagnosis of ITW was made by the children's physicians. Some studies were researched in a hospital setting while others conducted within children's pediatric outpatient clinics and orthopedic outpatient clinics. It is the physician's responsibility to write the child, who is experiencing ITW, a physical therapy referral and the parent's responsibility to give consent and provide the transportation and time for their child to benefit and participate in physical therapy.

Evaluation

An approach to the evaluation of a child with ITW should include: the medical history, gait evaluation, musculoskeletal examination, and neurologic examination. An important element of the evaluation process is to distinguish it from neuromuscular disorders associated with toe walking. Children experiencing toe walking should be evaluated with and without shoes. Shoes often disguise the true nature of a child's gait pattern. A thorough musculoskeletal examination

should be performed by the PT. The lower extremity examination of the child should display normal foot and leg alignment and appearance. During the evaluation process of ITW, special attention should be paid to the dorsiflexion of the ankle. Idiopathic toe walkers should demonstrate at least 5°-10° of passive ankle dorsiflexion. The child's deep tendon reflexes, vibratory, positional, pain, and temperature sensations as well as muscle strength should all be within normal limits. A measurement of ankle range of motion (ROM) is not reliable in distinguishing between ITW and other groups such as cerebral palsy and muscular dystrophy. While evaluating with a tread mat, the PT places the child in powder and then encourages them to walk along a darker colored piece of paper. This technique will reveal the percentage of forefoot and heel contact. It can also be used to evaluate the angle of gait, base of gait, length of step, and width of stride. Videotape analysis allows for both slow motion and stop frame evaluation of gait patterns. Using an electrodynogram during an initial evaluation of a child with ITW, can be a great help in determining the weight bearing pattern on the heel within the shoe.

In a research completed by Eastwood and partners, the evaluation was done by parent determined assessments and initial observation, depending on the type of previous treatments. The parents were asked to record the percentage of time their child spends on his/her toes. They were also ask to grade and classify the severity of their child's toe walking, ranging from the child walking on the tips of their toes to the heel was off the ground during gait only. The evaluation of Angulo and Stricker's retrospective study of ITW included measurements of pretreatment ankle dorsiflexion (measurements taken by a goniometer) and observation. Similar to Eastwood's research, the parents in this study were given a questionnaire to complete regarding their child. The questionnaire inquired about prematurity, developmental delay, neurologic consultations, and presence of heel-cord contractures at birth, family history of toe

walking, foot pain issues, poor balance, and shoe wear difficulty. The length of time the child remains on his/her toes compared to the total length of ambulation time and whether or not this ratio is increasing or decreasing is important in predicting the treatment method for the ITW. An accurate diagnosis and evaluation of ITW will prove to be essential in determining an efficient treatment intervention.

Treatment

ITW is associated with problems that warrant active treatment. Decreasing the toe walking attitude and accelerating the progression of a heel to toe gait is valuable in decreasing parent's anxiety as well as possibly reducing other conditions that may result from persistent toe walking. Some researchers conclude that untreated, persistent toe walking may place children at an increased risk for falling or developing limitations in ankle mobility and structural abnormalities. However, some studies have found that in the absence of treatment, mild progression of heel- cord contractures was as frequent as mild regression. Initial approach to children with ITW should consist of gait analysis, beginning with careful gait observation. Most children can be treated in a primary care setting with observation, conservative methods, or surgical treatment methods. Options for the treatment of ITW involve observation, nonoperative and operative management.

Conservative treatment includes observation, stretching, serial casting, splinting, and orthotics. Techniques for stretching that utilizes the child's body weight is recommended by most PT's. During a typical therapy session, a PT might have the child stand with the balls of their feet on a board or step and then drop their heels down for several repetitions. Manual passive dorsiflexion by a PT is often ineffective because of the strength of the plantar flexors seen in children. Depending on the severity of the toe walking, PT's might also recommend

serial casting as a treatment method for the child's Achilles tendon contractures and to improve ankle dorsiflexion. Serial cast are usually worn for six to eight weeks and involve the application of a series of below the knee casts with the foot initially casted in a neutral position. The casts are changed every one to two weeks to obtain progressively greater range of dorsiflexion through lengthening of the Achilles tendon. Articulated molded ankle foot orthosis (MAFO) is another conservative treatment option. It fits into any regular shoe and allows near normal dorsiflexion while simultaneously preventing plantar flexion. MAFO's are to be worn during all walking hours for a time span of six months. After the casts are removed, the child is instructed by the physician, under the supervision of the PT, to ambulate as tolerated. The PT's job is to ensure that the child is walking with their feet flat on the ground for a period of time, while the gastrocnemius and soleus muscles regain strength. PT's rarely recommend Botulinum toxin (Botox) but it is a treatment option. This particular treatment is used to paralyze the gastrocnemius muscle to allow effective stretching and retraining of muscles to obtain a normal gait. When conservative treatment has failed over a year's period of time for those who have severe contractures of the Achilles tendon, surgical intervention is the remaining method of treatment. This treatment option most commonly involves the lengthening of the Achilles tendon. Other methods of treatment for ITW include shoe and orthosis therapy. Shoe therapy consists of the use of a rigid sole oxford shoe. The rigid shoe restricts the child from dorsiflexion at his/her metatarsal- phalangeal joint, in result, bringing the heel down to the ground. The effectiveness of shoes in inhibiting toe walking can be enhanced by adding a 1/8 to 3/8 inch outer sole wedge. Orthosis therapy uses devices such as heel lifts, gait plates, and knee, ankle, and foot orthoses. The treatment of ITW often involves increasing the weight bearing pattern. Heel lifts are placed in shoes and are gradually reduced throughout the progression of

treatment. Gait plates are designed to induce out toe. They are used in flexible soled shoes and will often influence the bringing down of the heels. Knee, ankle, and foot orthoses are braces that prevent motion from occurring at the ankle. They can be used as both ambulatory devices and as night splints.

Eastwood and partners research on ITW consisted of 136 children. Group one included forty nine children who were treated with simple observation. Group two included forty one children who were treated with serial below the knee walking plaster casts for six weeks. Group three included forty six children who were treated by Achilles tendon lengthening and below the knee walking casts worn after surgery for six weeks. The patient-determined outcome for group one indicated that half of the subjects had an improved gait but the physician's determined outcome showed that only 12% of kids achieved a normal gait. At the beginning of the research, group two spent a median of 90% of time toe-walking. After treatment, the median improved to 70% but a normal gait within this group was rare. Group three, after treatment, showed clinically and statistically significant reductions in time spent walking on toes. The physician determined outcome showed 37% of children in this group had achieved a normal gait.

In a search to find the natural history of untreated ITW after the age of two, Angulo and Stricker conducted a research, similar to Eastwood, which consisted of eighty children. Group one was the observed, special shoe, or heel-cord stretching exercise group (48), group two was the serial cast and AFO followed by stretching exercise group (17), and group three was the surgical group (15). Only 25% of parents were satisfied with the outcome of observation. In both, groups one and two, there were some slight increases in ankle dorsiflexion in a few participants. Besides abnormal shoe wear, complications were rare in group one. A couple participants in group two, because of the casting treatment, developed partial thickness skin

pressure ulcerations on their feet. There were no complications reported for group three.

Ultimately, treatment recommendations for ITW are variable and not based on prospective studies or observation of its natural history.

Conclusion

Reading and researching ITW has revealed, not only to me but to other authors and researchers that this condition is more complex than one would imagine. Not knowing the origin or natural history of any condition or disease is an automatic handicap for anyone especially physicians, physical therapists, and researchers. According to previous studies, it can be concluded that the general belief of a child outgrowing his/ her toe walking habit overtime is true but only in terms of some improvement. Not all treatment methods will naturally restore or maintain a heel-toe gait pattern. ITW should be evident in a "healthy" child as he/she begins to walk. ITW should affect the child bilaterally and there should not be any spasticity present. Since ITW is habitual in nature, many researchers and PT's suggest that treatment for this particular condition should focus on traditional approaches and patient education; ultimately eliminating the need for surgery. During most studies for ITW, such as Eastwood and partners and Angulo and Stricker, behavioral issues and age of the children may have influenced the results. Follow-up visits at three to six months intervals, depending on the severity and treatment method, are recommended by physicians to reassure that this problem of toe walking is non-progressive. In three out of the four retrospective studies that were included and discussed, surgical treatment showed better results with respect to restoration of ankle dorsiflexion and parental satisfaction. It has been concluded that the majority of patients will resolve either on their own or with conservative treatment. Dr. Elizabeth Steiner stated, "Until there is a natural

history study of toe walking, we need to be watchful to not overmedicalize a problem that appears to run a benign course.”

Biases (Studies included)

- Treatments were not randomized
- Observers were not blinded to the treatment used
- Outcome measures of parental satisfaction was fairly subjective
- Some casting was performed by orthopedic residents with various levels of training
- Braces compliances were uncertain
- Entry level to experience PT's and PTA's participated (different skill levels)

Discussion (Author Suggestions)

Authors and researchers of ITW often have similar beliefs, findings, and outcomes but their experiences are different. After conducting research, studies and reviews of the natural history of ITW, some authors suggest and conclude the following:

- Anglade, Darlington, Ludwikowski, and Godwin concluded:
 - Since children with ITW were able to achieve a heel-toe gait; they possess the motor program to walk foot flat. Implying that toe walking is a preferential gait pattern.
- Angulo and Stricker theorized:
 - The purpose of toe walking may be to increase sensory stimulation.
- Babb and Carlson suggest:
 - ITW should be reviewed as a marker for developmental disorders.
- Caselli, Rzonca, and Lee suggest:

- Behavioral issues and age of children with ITW, who have participated in studies, may have influenced the results.
- Eastwood and partners concluded:
 - ITW persist in most children if left untreated or treated by serial casting.
- Eiff and Steiner suggest:
 - There is no convincing evidence that treatment is necessary for this condition.

Additional Research

More research for idiopathic toe walking needs to be conducted. Because ITW is obscure in origin, there are multiple questions that need to be addressed, answered, and determined through study. Additional research is needed to:

- Clarify how often ITW is outgrown
- Determine the natural history
- Impel optimal treatment methods for ITW
- Determine the length of treatment
- Determine specific indications for surgery needed for ITW

References

- Anglade, E., A. Darlington, H. Ludwikowski, and E. Godwin. "Gait Assessment of Children Demonstrating Habitual Toe Walking." *Pediatric Physical Therapy* 12.4 (2000): 206. Print.
- Babb, Aaron, and Walter O. Carlson. "Idiopathic Toe-Walking." *South Dakota Journal of Medicine* 61.2 (2008): 53+. Print.
- Barrett, Rowland P., and Dorothy M. Linn. "Treatment of Stereotyped Toe-Walking with Over Correction and Physical Therapy." *Applied Research in Mental Retardation* 2.1 (1981): 13-21. Print.
- Caselli, Mark A., Edward C. Rzonca, and Betty Y. Lue. "Habitual Toe Walking: Evaluation and Approach to Treatment." *Clinics in Podiatric Medicine and Surgery* 5.3 (1988): 547-59. Print.
- Clark, Elaine, Jane Sweeney, Allison Yocum, and Sarah McCoy. "Effects of Motor Control Intervention for Children with Idiopathic Toe Walking: A 5-Case Study." *Pediatric Physical Therapy* 2.4 (2010): 417-26. Print.
- Crenna, P., E. Fredrizzi, E. Andreucci, C. Frigo, and R. Bono. "The Heel- Contact Gait Pattern of Habitual Toe Walking." *Gait Posture* 21.3 (2005): 311-17. Print.
- Eastwood, Deborah, Malcom Menelaus, Robert Dickens, Nigel Broughton, and William Cole. "Idiopathic Toe-Walking: Does Treatment Alter the Natural History?" *Journal of Pediatric Orthopedics* 9.1 (2000): 47-49. Print.
- Eiff, Patrice, Elizabeth Steiner, and Dolores Judkins. "What Is the Appropriate Evaluation and Treatment of Children Who Are "Toe Walkers?"" *Journal of Family Practice* 55.5 (2006): 447-50. Print.
- Hemo, Yoram, Samuel Macdessi, Rosemary Pierce, Michael Aiona, and Michael Sussman. "Outcome of Patients after Achilles Tendon Lengthening for Treatment of Idiopathic Toe Walking." *Journal of Pediatric Orthopedics* 26 (2006): 336-39. Print.
- McMulkin, Mark, Glen Baird, Paul Caskey, and Ron Ferguson. "Comprehensive Outcomes of Surgically Treated Idiopathic Toe Walkers." *Journal of Pediatric Orthopedics* 26.5 (2006): 606-11. Print.

S., Stricker, and Angulo J.C. "Idiopathic Toe Walking: A Comparison of Treatment Methods." *Foot and Ankle Surgery* 5.1 (1999): 57. Print.